CLAIMS

1. A polymer electrolyte fuel cell comprising:

a fuel cell stack comprising a plurality of conductive separators and a plurality of membrane electrode assemblies that are stacked with one of said conductive separators interposed therebetween, each of said membrane electrode assemblies comprising a polymer electrolyte membrane, and an anode and a cathode sandwiching said polymer electrolyte membrane;

a means for supplying a fuel gas to said anode; and

a means for supplying an oxidant gas to said cathode,

wherein said plurality of conductive separators comprise at least one separator comprising: a fuel gas inlet-side manifold aperture; a fuel gas outlet-side manifold aperture; a gas flow channel for supplying the fuel gas to said anode which is formed on an anode-side of the separator; an inlet-side through hole and an outlet-side through hole penetrating the separator which are formed at an inlet-side end and an outlet-side end of said gas flow channel for fuel gas; and an inlet-side connection groove and an outlet-side connection groove for connecting said inlet-side and outlet-side through holes with said fuel gas inlet-side manifold aperture and said fuel gas outlet-side manifold aperture, respectively, which

are formed on a cathode-side of the separator.

2. The polymer electrolyte fuel cell in accordance with claim 1, wherein said at least one separator further comprises: an oxidant gas inlet-side manifold aperture; an oxidant gas outlet-side manifold aperture; a gas flow channel for supplying the oxidant gas to said cathode which is formed on said cathode-side; an inlet-side through hole and an outlet-side through hole penetrating the separator which are formed at an inlet-side end and an outlet-side end of said gas flow channel for oxidant gas; and an inlet-side connection groove and an outlet-side connection groove for connecting said inlet-side and outlet-side through holes with said oxidant gas inlet-side manifold aperture and said oxidant gas outlet-side manifold aperture, respectively, which are formed on said anode-side.

3. The polymer electrolyte fuel cell in accordance with claim 1,

wherein said at least one separator further comprises a cooling water inlet-side manifold aperture and a cooling water outlet-side manifold aperture,

said plurality of conductive separators comprise a combination of two separator members consisting of an anode-side separator member and a cathode-side separator member, each separator member comprising at least a fuel gas inlet-side manifold aperture, a fuel gas outlet-side

manifold aperture, a cooling water inlet-side manifold aperture, and a cooling water outlet-side manifold aperture, said two separator members being combined in such a manner that their backsides are in contact with each other,

said anode-side separator member further comprises: a gas flow channel for supplying the fuel gas to said anode which is formed on an anode-side of the anode-side separator member; an inlet-side through hole and an outlet-side through hole penetrating the anode-side separator member which are formed at an inlet-side end and an outlet-side end of said gas flow channel; and an inlet-side connection groove and an outlet-side connection groove for connecting said inlet-side and outlet-side through holes with said fuel gas inlet-side manifold aperture and said fuel gas outlet-side manifold aperture, respectively, which are formed on the backside of the anode-side separator member,

at least one of said two separator members has, on the backside thereof, a cooling water flow channel communicating with said cooling water inlet-side manifold aperture and said cooling water outlet-side manifold aperture such that the cooling water flow channel is formed between said two separator members, and

said respective manifold apertures of said at least one separator communicate with said corresponding

manifold apertures of each of said two separator members.

4. The polymer electrolyte fuel cell in accordance with claim 3,

wherein said at least one separator further comprises an oxidant gas inlet-side manifold aperture and an oxidant gas outlet-side manifold aperture,

said two separator members further comprise an oxidant gas inlet-side manifold aperture and an oxidant gas outlet-side manifold aperture,

said cathode-side separator member further comprises: a gas flow channel for supplying the oxidant gas to said cathode which is formed on a cathode-side of the cathode-side separator member; an inlet-side through hole and an outlet-side through hole penetrating the cathode-side separator member which are formed at an inlet-side end and an outlet-side end of said gas flow channel; and an inlet-side connection groove and an outlet-side connection groove for connecting said inlet-side and outlet-side through holes with said oxidant gas inlet-side manifold aperture and said oxidant gas outlet-side manifold aperture, respectively, which are formed on the backside of the cathode-side separator member, and

said respective oxidant gas manifold apertures of said at least one separator communicate with said corresponding oxidant gas manifold apertures of each of said two separator members.

5. The polymer electrolyte fuel cell in accordance with claim 1,

wherein said at least one separator further comprises a cooling water inlet-side manifold aperture and a cooling water outlet-side manifold aperture,

said plurality of conductive separators comprise a combination of two separator members consisting of an anode-side separator member and a cathode-side separator member, each separator member comprising at least a fuel gas inlet-side manifold aperture, a fuel gas outlet-side manifold aperture, a cooling water inlet-side manifold aperture, and a cooling water outlet-side manifold aperture, said two separator members being combined in such a manner that their backsides are in contact with each other,

said anode-side separator member further comprises: a gas flow channel for supplying the fuel gas to said anode which is formed on an anode-side of the anode-side separator member; and an inlet-side through hole and an outlet-side through hole for fuel gas penetrating the anode-side separator member which are formed at an inlet-side end and an outlet-side end of said gas flow channel,

said cathode-side separator member further comprises: an inlet-side through hole and an outlet-side through hole for fuel gas communicating with said inlet-side and outlet-side through holes for fuel gas of said

anode-side separator member; and an inlet-side connection groove and an outlet-side connection groove for connecting said inlet-side and outlet-side through holes for fuel gas of said cathode-side separator member with said fuel gas inlet-side manifold aperture and said fuel gas outlet-side manifold aperture, respectively, which are formed on a cathode-side of the cathode-side separator member,

at least one of said two separator members has, on the backside thereof, a cooling water flow channel communicating with said cooling water inlet-side manifold aperture and said cooling water outlet-side manifold aperture such that the cooling water flow channel is formed between said two separator members, and

said respective manifold apertures of said at least one separator communicate with said corresponding manifold apertures of each of said two separator members.

6. The polymer electrolyte fuel cell in accordance with claim 5,

wherein said at least one separator further comprises an oxidant gas inlet-side manifold aperture and an oxidant gas outlet-side manifold aperture,

said two separator members further comprise an oxidant gas inlet-side manifold aperture and an oxidant gas outlet-side manifold aperture,

said cathode-side separator member further comprises: a gas flow channel for supplying the oxidant gas

to said cathode which is formed on said cathode-side; and an inlet-side through hole and an outlet-side through hole for oxidant gas penetrating the cathode-side separator member which are formed at an inlet-side end and an outlet-side end of said gas flow channel,

said anode-side separator member further comprises: an inlet-side through hole and an outlet-side through hole for oxidant gas communicating with said inlet-side and outlet-side through holes for oxidant gas of said cathode-side separator member; and an inlet-side connection groove and an outlet-side connection groove for connecting said inlet-side and outlet-side through holes for oxidant gas of said anode-side separator member with said oxidant gas inlet-side manifold aperture and said oxidant gas outlet-side manifold aperture, respectively, which are formed on said anode-side, and

said respective oxidant gas manifold apertures of said at least one separator communicate with said corresponding oxidant gas manifold apertures of each of said two separator members.

7. The polymer electrolyte fuel cell in accordance with claim 4,

wherein said membrane electrode assembly further comprises a gasket covering an outer periphery of said anode and said cathode, and

said gasket comprises a fuel gas inlet-side

manifold aperture, a fuel gas outlet-side manifold aperture, an oxidant gas inlet-side manifold aperture, an oxidant gas outlet-side manifold aperture, a cooling water inlet-side manifold aperture, and a cooling water outlet-side manifold aperture, said respective manifold apertures of said gasket communicating with said corresponding manifold apertures of each of said two separator members.

8. The polymer electrolyte fuel cell in accordance with claim 6,

wherein said membrane electrode assembly further comprises a gasket covering an outer periphery of said anode and said cathode, and

said gasket comprises a fuel gas inlet-side manifold aperture, a fuel gas outlet-side manifold aperture, an oxidant gas inlet-side manifold aperture, an oxidant gas outlet-side manifold aperture, a cooling water inlet-side manifold aperture, and a cooling water outlet-side manifold aperture, said respective manifold apertures of said gasket communicating with said corresponding manifold apertures of each of said two separator members.

9. A conductive separator for a polymer electrolyte fuel cell, comprising: a fuel gas inlet-side manifold aperture; a fuel gas outlet-side manifold aperture; an oxidant gas inlet-side manifold aperture; an oxidant gas outlet-side manifold aperture; a gas flow channel for fuel gas formed on an anode-side of the

separator; a gas flow channel for oxidant gas formed on a cathode-side of the separator; an inlet-side through hole and an outlet-side through hole for fuel gas penetrating the separator which are formed at an inlet-side end and an outlet-side end of said gas flow channel for fuel gas; an inlet-side through hole and an outlet-side through hole for oxidant gas penetrating the separator which are formed at an inlet-side end and an outlet-side end of said gas flow channel for oxidant gas; an inlet-side connection groove and an outlet-side connection groove for connecting said inlet-side and outlet-side through holes for oxidant gas with said oxidant gas inlet-side manifold aperture and said oxidant gas outlet-side manifold aperture, respectively, which are formed on said anode-side; and an inlet-side connection groove and an outlet-side connection groove for connecting said inlet-side and outlet-side through holes for fuel gas with said fuel gas inlet-side manifold aperture and said fuel gas outlet-side manifold aperture, respectively, which are formed on said cathode-side.

10. A conductive separator for a polymer electrolyte fuel cell, comprising a combination of two separator members consisting of an anode-side separator member and a cathode-side separator member, each separator member comprising a fuel gas inlet-side manifold aperture, a fuel gas outlet-side manifold aperture, an oxidant gas inlet-side manifold aperture, an oxidant gas outlet-side

manifold aperture, a cooling water inlet-side manifold aperture, and a cooling water outlet-side manifold aperture, said two separator members being combined in such a manner that their backsides are in contact with each other,

wherein said anode-side separator member further comprises: a gas flow channel for fuel gas formed on an anode-side of the anode-side separator member; an inlet-side through hole and an outlet-side through hole for fuel gas penetrating the anode-side separator member which are formed at an inlet-side end and an outlet-side end of said gas flow channel for fuel gas; and an inlet-side connection groove and an outlet-side connection groove for connecting said inlet-side and outlet-side through holes for fuel gas with said fuel gas inlet-side manifold aperture and said fuel gas outlet-side manifold aperture, respectively, which are formed on the backside of the anode-side separator member,

said cathode-side separator member further comprises: a gas flow channel for oxidant gas formed on a cathode-side of the cathode-side separator member; an inlet-side through hole and an outlet-side through hole for oxidant gas penetrating the cathode-side separator member which are formed at an inlet-side end and an outlet-side end of said gas flow channel for oxidant gas; and an inlet-side connection groove and an outlet-side connection groove

for connecting said inlet-side and outlet-side through holes for oxidant gas with said oxidant gas inlet-side manifold aperture and said oxidant gas outlet-side manifold aperture, respectively, which are formed on the backside of the cathode-side separator member, and

at least one of said two separator members has, on the backside thereof, a cooling water flow channel communicating with said cooling water inlet-side manifold aperture and said cooling water outlet-side manifold aperture such that the cooling water flow channel is formed between said two separator members.

11. A conductive separator for a polymer electrolyte fuel cell, comprising a combination of two separator members consisting of an anode-side separator member and a cathode-side separator member, each separator member comprising a fuel gas inlet-side manifold aperture, a fuel gas outlet-side manifold aperture, an oxidant gas inlet-side manifold aperture, an oxidant gas outlet-side manifold aperture, a cooling water inlet-side manifold aperture, and a cooling water outlet-side manifold aperture, said two separator members being combined in such a manner that their backsides are in contact with each other,

wherein said anode-side separator member further comprises: a gas flow channel for fuel gas formed on an anode-side of the anode-side separator member; and an

inlet-side through hole and an outlet-side through hole for fuel gas penetrating the anode-side separator member which are formed at an inlet-side end and an outlet-side end of said gas flow channel for fuel gas,

said cathode-side separator member further comprises: a gas flow channel for oxidant gas formed on a cathode-side of the cathode-side separator member; and an inlet-side through hole and an outlet-side through hole for oxidant gas penetrating the cathode-side separator member which are formed at an inlet-side end and an outlet-side end of said gas flow channel for oxidant gas,

said anode-side separator member further comprises: an inlet-side through hole and an outlet-side through hole for oxidant gas communicating with said inlet-side and outlet-side through holes for oxidant gas of said cathode-side separator member; and an inlet-side connection groove and an outlet-side connection groove for connecting said inlet-side and outlet-side through holes for oxidant gas of said anode-side separator member with said oxidant gas inlet-side manifold aperture and said oxidant gas outlet-side manifold aperture, respectively, which are formed on said anode-side,

said cathode-side separator member further comprises: an inlet-side through hole and an outlet-side through hole for fuel gas communicating with said inlet-side and outlet-side through holes for fuel gas of said

anode-side separator member; and an inlet-side connection groove and an outlet-side connection groove for connecting said inlet-side and outlet-side through holes for fuel gas of said cathode-side separator member with said fuel gas inlet-side manifold aperture and said fuel gas outlet-side manifold aperture, respectively, which are formed on said cathode-side, and

at least one of said two separator members has, on the backside thereof, a cooling water flow channel communicating with said cooling water inlet-side manifold aperture and said cooling water outlet-side manifold aperture such that the cooling water flow channel is formed between said two separator members.